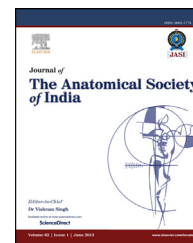


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Editorial

Portal vein blood flow – An anatomical and physiological enigma



Vishram Singh*

Professor and Head, Department of Anatomy, Santosh Medical College, Ghaziabad, Uttar Pradesh, India

1. Introduction

The portal vein enjoys a unique status among the veins of the body in the sense that it not only collects the blood of reduced oxygenation but rich in nutrients from abdominal part of alimentary tract and carry it to the liver.

The portal vein begins at the level of second lumbar vertebra anterior to inferior vena cava and posterior to the neck of pancreas by the convergence of superior mesenteric (SMV) and splenic veins. The splenic vein carries products of RBC breakdown from spleen and SMV carries absorbed nutrients from the intestines.¹ It is about 8 cm long in adults. It ascends with obliquity to the right to reach the right end of porta-hepatis of the liver where it then divides into right and left branches.

These branches accompany the corresponding branches of the hepatic artery into the liver to supply nutrients to the parenchyma in segmental pattern.² The short right branch usually forms the anterior division which supplies segment V and VIII, and a posterior division which supplies the segments VI and VII of right true/physiological lobe. The left branch is longer and takes a long extra-parenchymatous course and tends to lie slightly more horizontal than the right branch but is often of small calibre. It supplies segments I(caudate), II, III and IV(quadrante) of the liver.

The liver has dual blood supply, 80% by the portal vein and 20% by the hepatic artery. The relationship between the portal venous and hepatic arterial blood flows is autoregulated within the liver. This “buffer response” permits maintenance of hepatic blood flow within limits by reciprocal changes between hepatic arterial conduction and portal vein blood flow.³

The portal vein supplies the liver only with 5% of its resting oxygen consumption but significantly more of its metabolic nutrition. This is evident from the fact that the progressive occlusion of hepatic artery rarely results in complete necrosis of the liver which is due principally to the blood supply derived from the portal vein.

The blood in the portal vein flows at a sluggish rate as a result streaming occurs so that the blood from splenic vein tends to remain on the left side of the portal blood stream and pass mostly to the left liver. The blood from superior mesenteric veins remains on the right side of portal blood stream and pass mostly to the right liver (Fig. 1).

The evidences to support this fact are:

- In case of ingested liver poisons, their absorption from small intestine into the SMV result in greater concentration of poison into the right lobe of liver which therefore shows more toxic changes while the left lobe of liver does not show any such changes.
- In nutritional protein deficiencies of substances like methionine and choline, the left lobe hardly receives any of these substances. Being deprived of any of these amino acids the left lobe undergoes chronic cirrhotic changes while right lobe of liver remains normal.⁴

2. Discussion

The flow of blood in vessels occurs in two ways: a) when blood flows at a steady rate through a long smooth vessel, with each layer of blood remaining at same distance from the vessel

* Tel.: +91 8800534822.

E-mail addresses: editorjasi@gmail.com, drvishramsingh@gmail.com, <http://dx.doi.org/10.1016/j.jasi.2014.04.010>

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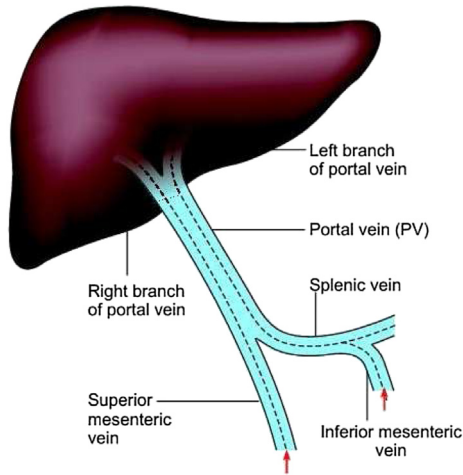


Fig. 1 – Streaming of portal blood flow.

wall. Also the central portion of blood stays in centre, this type of blood flow is called Laminar or Streamline flow.⁵ The velocity of blood in the vessel is inversely related to its total cross-sectional area and also differs per cross-section. For this reason the blood flow velocity is the fastest in the middle of the vessel and slowest at the vessel wall.⁶ b) On the other hand, when blood flows in all directions in the vessels and continuing mixing occurs within the vessel, it is called Turbulent flow⁵ (Fig. 2).

In case of portal vein, the two streams of blood come from different directions, more or less at right angle to each other, to flow together through a common final pathway. While passing through the common pathway – portal vein, these two streams do not mix with each other either at all or very little (vide supra). The streaming in the portal vein may occur due to multiple factors: a. sluggishness of blood flow; b. direction of two streams before passing through the common channel; c. velocity of two streams.

This unique phenomenon of flow of two streams of blood in portal vein without mixing with each other is akin to the “Sangam of Ganga and Yamuna” i.e meeting of two holy rivers in famous Indian religious city of Allahabad (UP) where the water streams of two rivers flow together in same direction in

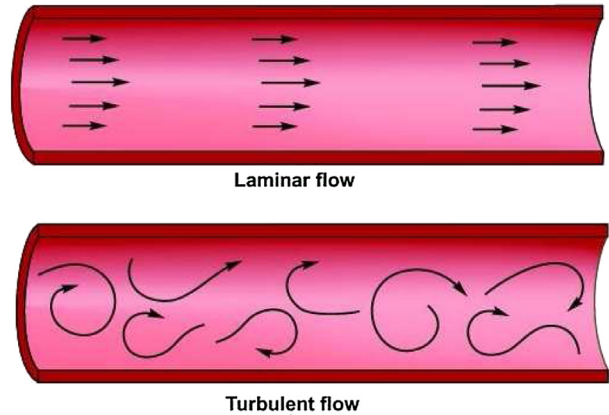


Fig. 2 – Types of blood flow.

contiguity without mixing. The line of separation of two streams of the water on the surface is clearly visible because of difference in colours of water in two rivers. Therefore it is opined that this unique mode of blood flow in the portal vein should be coined as “Sangam Dictum”. It is also suggested that further research work is required using advanced and recent techniques to validate the above phenomenon.

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